SAUDI PORTS AUTHORITY JEDDAH ISLAMIC PORT

PRIMARY EVALUATION REPORT OF ANCHOR TESTS

DOCUMENT NO: KASK-2023-U-SA-01-DE-REP-002-R00

00	26.10.2023	First Submission	Ahmet DİNÇ	Şenol ADATEPE	Şenol ADATEPE
Rev	**Date**	**Description**	**Prepared by**	**Checked by**	**Approved by**

1 INTRODUCTION

The purpose of this report is to present results and the primary evaluations of anchor test performed within the scope of content of Development of the Port Platform (From 26 To 31) Project Jeddah Islamic Seaport (JIP), Jeddah – KSA.

Test anchor (TA-2) was executed in accordance with method statement "**KASK-2023-U-SA-01-DE-MS-002-R00** " dated on 17.04.2023. This test anchor was tested at 25.10.2023.

The details of the test anchors are summarized hereunder:

1) Test anchors were performed consisting of 10 number of [(3x 0.62")+(3x 0.62")+(4x 0.62")] Dia.: 15.7 mm 7-wire strand. For 3-unit system, bottom anchor unit consists of 4 no, middle and top anchor units consist of 3 no. of Dia.: 15.24 mm 7- wire strands.
2) Post grouting has been carried out in order to improve the surrounding soil around the fixed anchor bond length. Besides, the risk of grout washing away due to high water pressure shall also be eliminated and/or limited.

Table 1: Test Anchor Information

No	Technique	Strand	Free Length Length (m)	Drilling Diameter (mm)
T2	SBMA (Three bonded)	(3x 0.62")+(3x 0.62")+(4x 0.62")	26.5	215

The test anchor section is given below.

The TA-2 (Anchor No. 145) test result is given below.

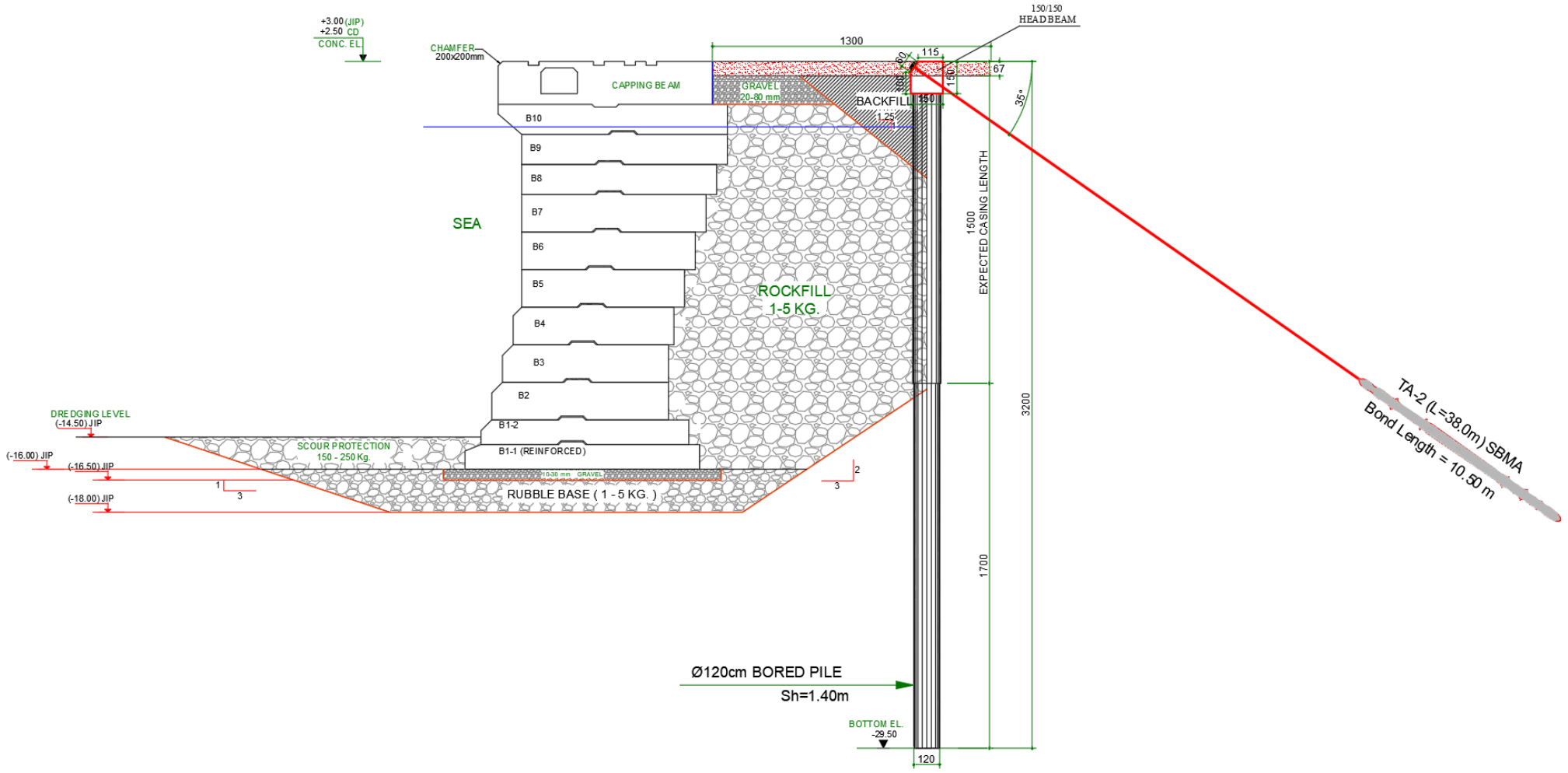


Figure 1: Ground section for T2 anchors

KASKTAS ARABIA LTD.

SBMA - Investigation Test (Ref to: BS 8081)

Anchor No	145
Test Date	25.10.2023
Page	1 / 2

Project: REHABILITATION OF BERTHS 26 TO 31 AT JEDDAH ISLAMIC PORT

3.5 m Bond (3 Strands) + 3.5 m Bond (3 Strands) +3.5 m Bond (4 Strands)

3 Unit

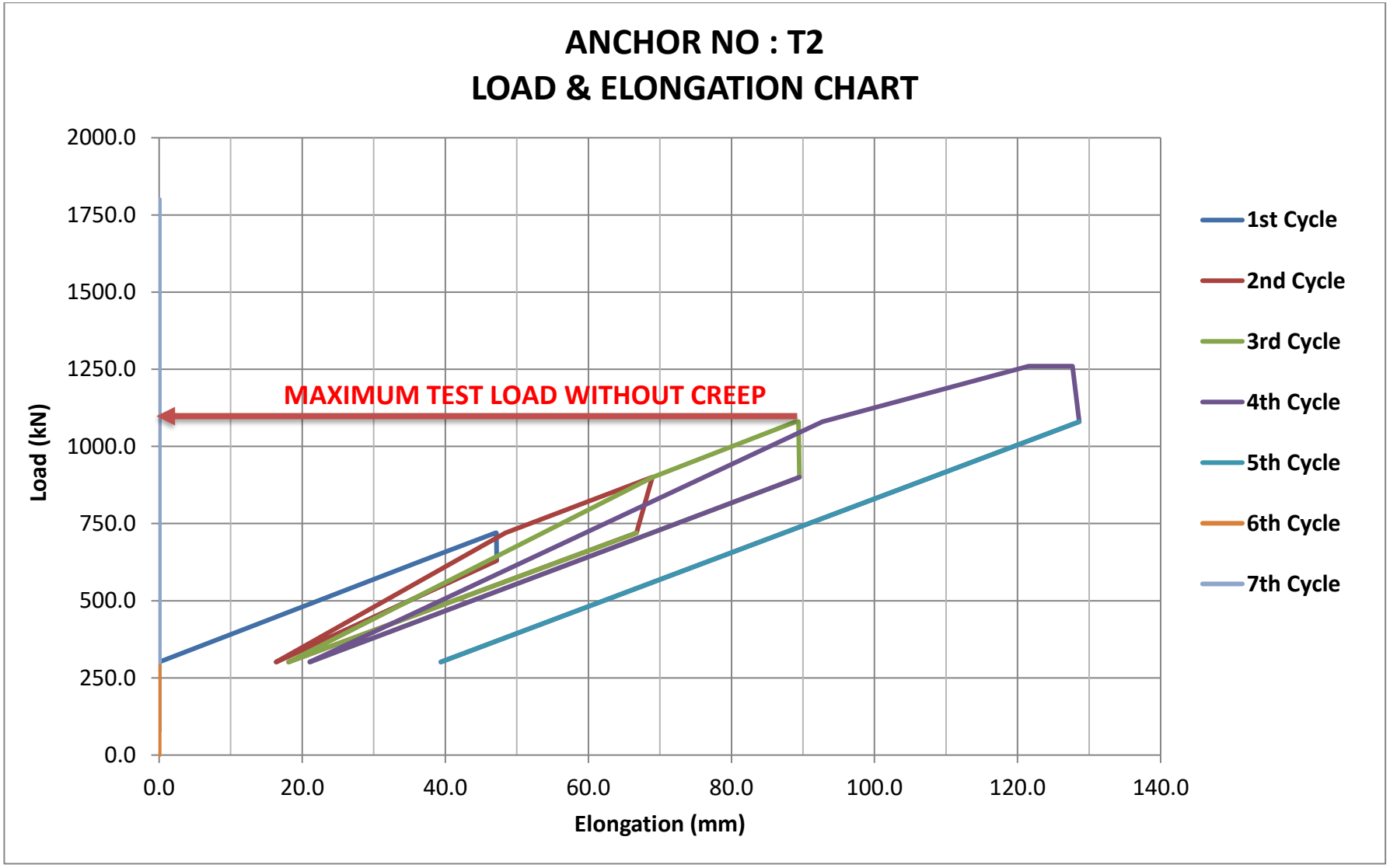
Anchor No	T2	Ex. Date	
Anchor Type	SBMA		

Anchor Detail	Unit-3	Unit-2	Unit-1
Tendon Number	4	3	3
Tendon Diameter (mm)	15.24	15.24	15.24
Tendon Area (mm²):	140	140	140
Free Length (m):	34.5	30.5	26.5
Average Stress Length (m):	3.0	3.0	3.0
Bond Length (m):	3.5	3.5	3.5
Creep Load / Failure Load (kN):		246	260
E-Modulus (kN/mm2):		200	
Tendon Steel Class (MPa)		1860	

Stressing Test Equipment	
Jack Type	SJM-27035
Piston/Ram Diameter (cm2):	384.8
	-
	-
Test Parametres:	
Failure Load, Ptk (kN)	2600
Design Load (kN)	1200
Maximum Test Load, Pp (kN)	1800
Cure time(day):	

Stage	Cycle	Pressure	Load	P/Pp*	Anchor strecth (mm) Observation Time (min)												Creep "ks"
		P (bar)	P (kN)	(%)	0	1	2	3	4	5	7	10	15	20	30	45	60	mm
Pre-1	Pre	21	76.8	4%		Unit-1 Stress, Unit-2 Wedge Activate												
Pre-2		58	218.1	12%		Unit 1 and 2 Stress, Unit-3 Wedge Activate												
Pre-3		79	301.5	17%		Datum Load												
1	1	165	630.0	35%	36.80	36.86												
2		188	720.0	40%	47.04	47.12	47.12	47.13	47.13	47.13	47.19	47.19	47.19					0.00
3		165	630.0	35%	47.19	47.19												
4		79	301.5	17%	16.36	16.36												
5	2	188	720.0	40%	48.39	48.57												
6		234	900.0	50%	68.88	68.90	68.91	68.92	68.92	68.93	68.94	68.95	68.96					0.10
7		188	720.0	40%	66.74	66.74												
8		79	301.5	17%	18.10	18.10												
9	3	234	900.0	50%	68.98	70.22												
10		281	1080.0	60%	88.99	89.15	89.24	89.31	89.34	89.36	89.38	89.42	89.58					0.21
11		234	900.0	50%	89.51	89.51												
12		79	301.5	17%	21.06	21.06												
13	4	281	1080.0	60%	92.70	92.89	MAXIMUM TEST LOAD WITHOUT CREEP											
14		327	1260.0	70%	121.55	121.69	121.91	122.99	124.80	126.21	126.72	127.68	128.77					14.55
15		281	1080.0	60%	128.62	128.62												
16		79	301.5	17%	39.37	39.37												
17	5	327	1260.0	70%	139.69	140.36												
18		373	1440.0	80%														0.00
19		327	1260.0	70%														
20		79	301.5	17%														
21	6	373	1440.0	80%														
22		419	1620.0	90%														0.00
23		373	1440.0	80%														
24		79	301.5	17%														
25	7	419	1620.0	90%														
26		466	1800.0	100%														0.00
27		419	1620.0	90%														
28		79	301.5	17%														

Note: Creep check will be observed for at least 15 min at the max load at each cycle. After 15 min, if creep value is over 2 mm, readings will continue until creep value drops below 2 mm. After 60 min, is creep value is over 3 mm, next steps will be taken to determine the anchor peel load.


ANCHOR NO : T2
LOAD & ELONGATION CHART
2000.0
1750.0
1500.0
1250.0
1000.0
750.0
500.0
250.0
0.0
Load (kN)
MAXIMUM TEST LOAD WITHOUT CREEP
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
Elongation (mm)
1st Cycle
2nd Cycle
3rd Cycle
4th Cycle
5th Cycle
6th Cycle
7th Cycle

2 EVALUATION

Maximum test load without creep = 1080 kN

Ultimate load capacity for Single Unit= 1080/3 = 360 kN (L_{bond} = 10.5m)

Proposal for 5 Unit SBMA Anchor (L_{bond} = 19.5m)

Ultimate load capacity for 5-Unit= 360x5 = 1800 kN (L_{bond} = 19.5m)

Allowable anchor load capacity = 1800/1.5 = 1200 kN

Safety Check for Ground-Grout Interface

TA-2 (τ_{ult} = 152.3kPa) (from field tests)

Based on previous experience an encapsulated (corrugated plastic duct) unit length of 3.5m will be considered for each unit with 0.5m spacing between each unit. The 0.5m spacing between units is derived from experience and is intended to prevent in interaction between unit fixed anchors.

Assumed borehole diameter is 215mm

Considering the above ultimate bond stress, the ultimate capacity per unit:

$$T_{ult} = \pi.d.L.\tau_{ult}$$

Where:

T_{ult} = ultimate unit anchor capacity

L = unit anchor length and

τ_{ult} = ultimate bond stress

f_{eff} = efficiency factor allowing for the effect of progressive debonding ($1.6.L^{-0.57}$)

Consider L = 3.5m and d = 0.215m

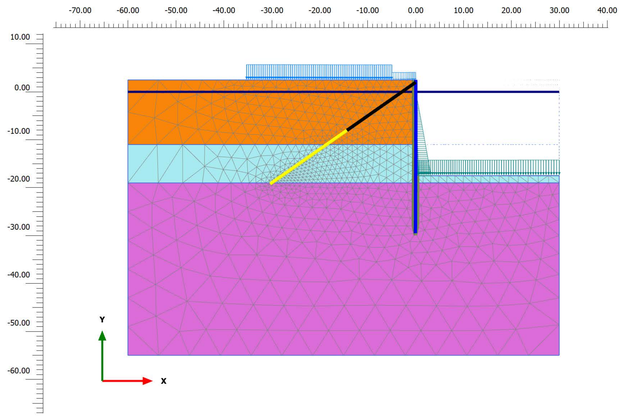
T_{ult} = = π x 0.215 x 3.5 x (152.3) = 360 kN (Single Unite Ultimate Load Capacity)

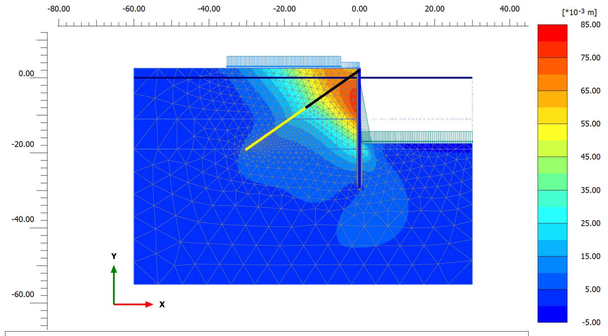
T_{ult} = 360x5 = 1800 kN (Theoretical 5 – Unite Ultimate Load Capacity)

T_d = 1800 kN/1.5 = 1200 kN (Allowable 5 - Unite Capacity) ...OK

A ground anchor investigation test was made on Anchor No. 145 on October 25, 2023. The anchor 145 (TA-2) has carried 108 tons of load safely, so we can estimate 36 tons per bond. Hereupon, we want to revise the anchor design as per the attachment and submit it to you without changing the anchor length. We just increased the number of anchor bonds from 3 to 5. Therefore, we request to increase the number of SBMA anchor units from 3 to 5. Thus, the bond length will increase from 10.5 meters to 19.50 meters, and according to the TA-2 result, it will meet the design load of 1200 kN. In addition, according to the TA-2 result, we evaluate that the 5-unit SBMA anchor will pass the 1800 kN test load without creep.

Below is a summary of the Plaxis 2D analysis required for the 5-Bond SBMA revision. According to these results, the factor of safety against a whole collapse is over 1.35. The internal loads of the bored pile are almost the same as in the existing design. In summary, only with this revision will the anchor bond length and number of units change.

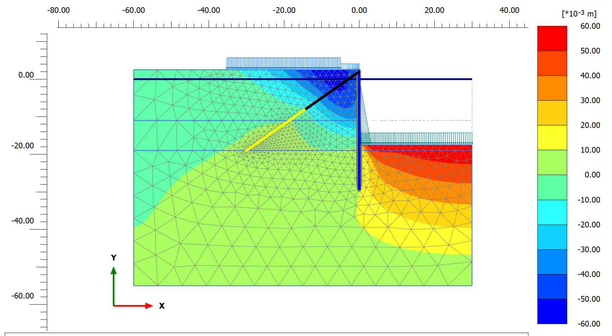




Total displacements u_x (scaled up 50.0 times)

Maximum value = 0.08191 m (Element 337 at Node 8002)

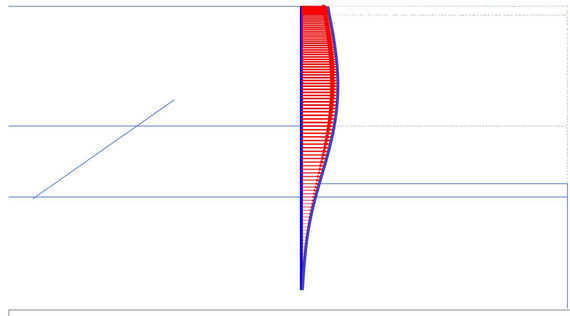
Minimum value = -1.069*10^{-3} m (Element 1258 at Node 1725)



Total displacements u_y (scaled up 20.0 times)

Maximum value = 0.05959 m (Element 1254 at Node 159)

Minimum value = -0.05503 m (Element 241 at Node 12322)



Total displacements u_x (scaled up 50.0 times)

Maximum value = 0.08229 m (Element 10 at Node 5640)

Minimum value = 2.093*10^{-3} m (Element 25 at Node 2612)

Step info

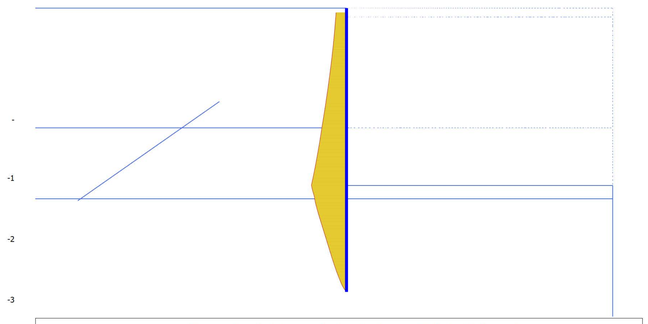
Phase	Phase_4 [Phase_4]
Step	Initial
Calulation mode	Classical mode
Step type	Safety
Updated mesh	False
Solver type	Picos
Kernel type	64 bit
Extrapolation factor	1.000
Relative stiffness	2.568E-3

Multipliers

Soil weight			ΣM_{Weight}	1.000
Strength reduction factor	M_{sf}	-0.1647E-3	ΣM_{sf}	1.497
Time	Increment	0.000	End time	0.000

Structural element	Node	Local number	X [m]	Y [m]	N [kN]	N_{min} [kN]	N_{max} [kN]
NodeToNodeAnchor_1_1	6130	1	0.000	2.000	1200.000	0.000	1200.000
Element 1-1 (Node-to-node anchor)	13098	2	-14.335	-8.038	1200.000	0.000	1200.000

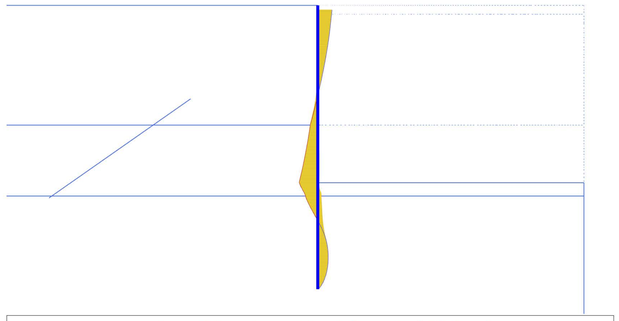
FoS = 1. 497



Envelope of Axial forces N (scaled up 5.00*10^{-3} times)

Maximum value = 0.06915 kN/m (Element 1 at Node 5935)

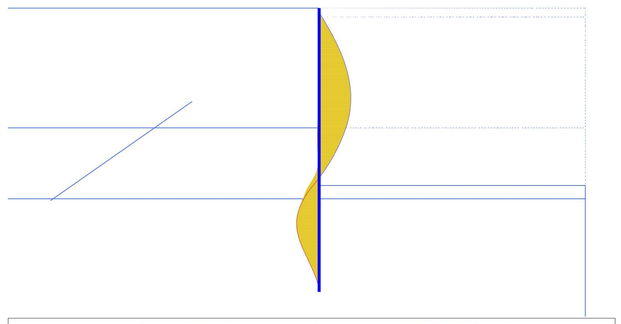
Minimum value = -793.1 kN/m



Envelope of Shear forces Q (scaled up 5.00*10^{-3} times)

Maximum value = 320.2 kN/m (Element 2 at Node 6130)

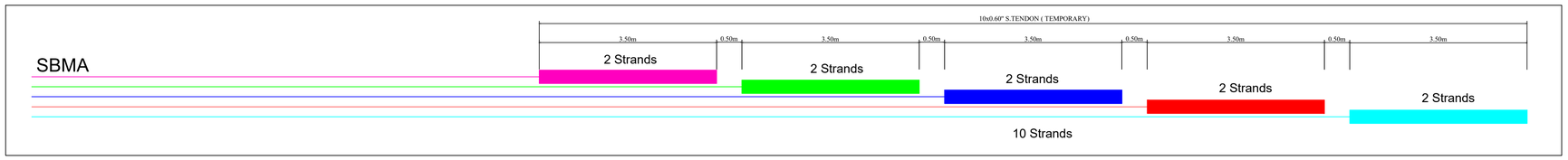
Minimum value = -422.3 kN/m



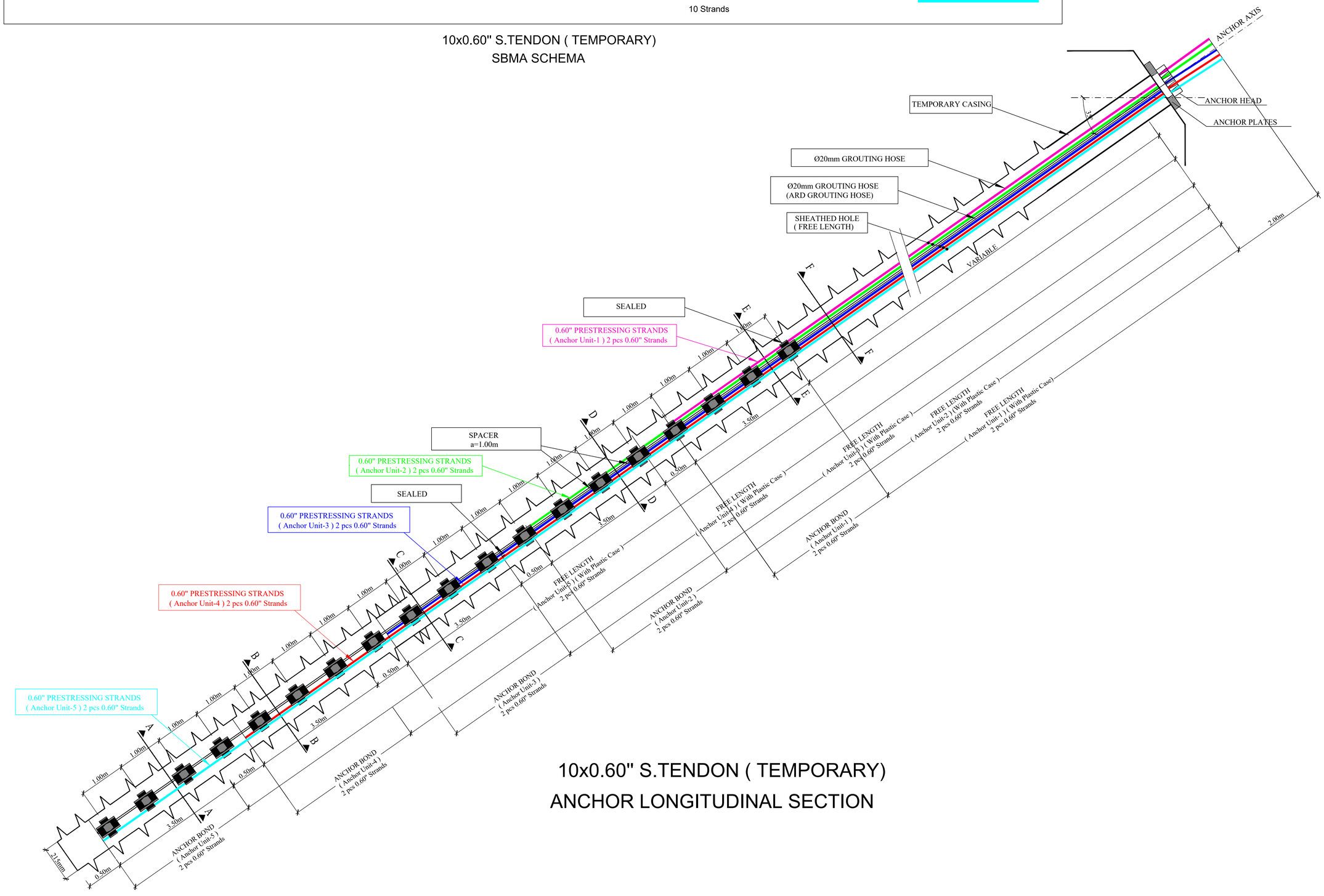
Envelope of Bending moments M (scaled up 2.00*10^{-3} times)

Maximum value = 1786 kN m/m (Element 11 at Node 5617)

Minimum value = -1276 kN m/m



10x0.60" S.TENDON (TEMPORARY)
SBMA SCHEMA



10x0.60" S.TENDON (TEMPORARY)
ANCHOR LONGITUDINAL SECTION

GENERAL NOTES

1- MATERIALS :

CONCRETE :
C35 Concrete with min. compressive strength of 35 N/mm² shall be used for RC beam.

REINFORCEMENT :
B500A,B (min. fyk = 500 MPa)

2- CONCRETE COVER :

The minimum clear cover to steel reinforcement shall be as follows.
Shoring Bored Piles Ø1200mm : 50-60mm from Casing
Head Beam : 50mm

3- LAP LENGTH of REBAR

For the head beam, lap length shall satisfy min. 50Ø for longitudinal rebars. Also, stirrups spacing shall be 10 cm for lab region.

4- SCALE :

Unless otherwise indicated on drawings all distances are in cm, elevation in meters, and reinforcement bar sizes in mm.

NO.	DATE	REVISION
A		
A		
A		
A		
A	26.10.2023	GENERAL REVISION

PROJECT NAME: SAUDI PORTS AUTHORITY
JEDDAH ISLAMIC PORT

SUBCONTRACTOR: KASKTAS ARABIA LTD.
PILING - DRILLING CONTRACTING CO. LTD.
P.O.Box 15089 Jeddah 21444 KSA Tel:00966-2-6695228 Fax:00966-2-6652704
web site: www.kasktas.com.tr email : kasktas@kasktasarabia.com

	NAME	DATE	SIGNATURE
DRAWN BY	ÖMER CELEBİ	12.04.2023	
DESIGNED BY	AHMET DİNÇ	12.04.2023	
CHECKED & APPROVED BY	SENOL ADATEPE	12.04.2023	

PROJECT-DRAWING TITLE :
10x0.60" S.TENDON (TEMPORARY)
ANCHOR DETAILS

PROJECT NO : 2023-U.SA-01
SCALE 1/200

DWG. NO. KASK-2023-U-SA-01-DE-DWG-012-R01

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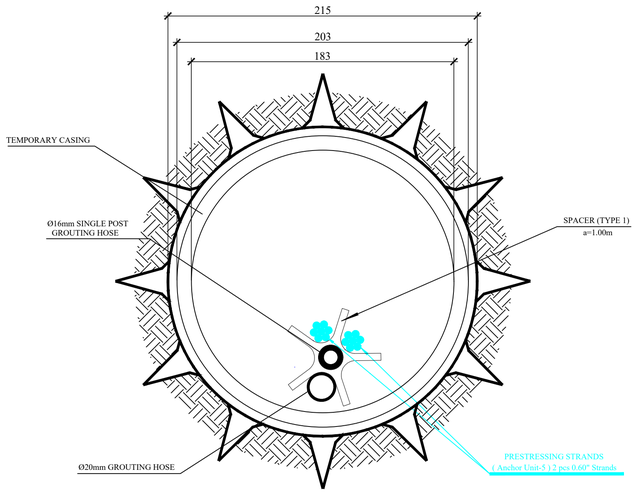
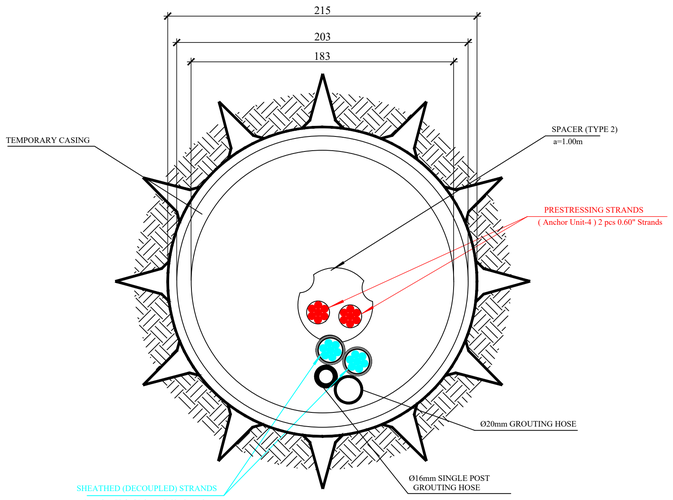
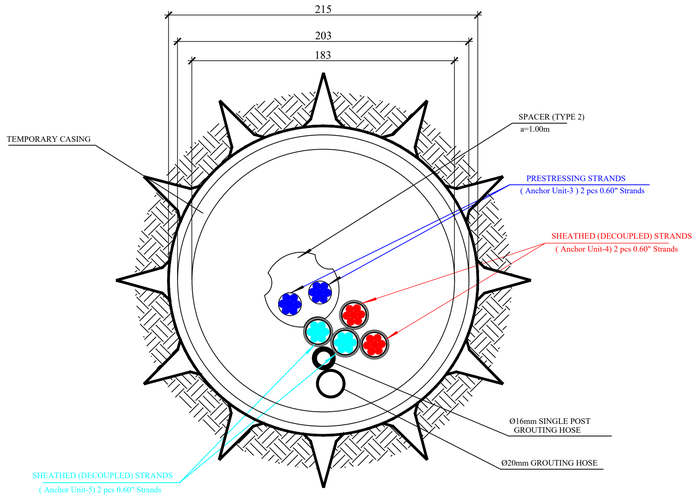


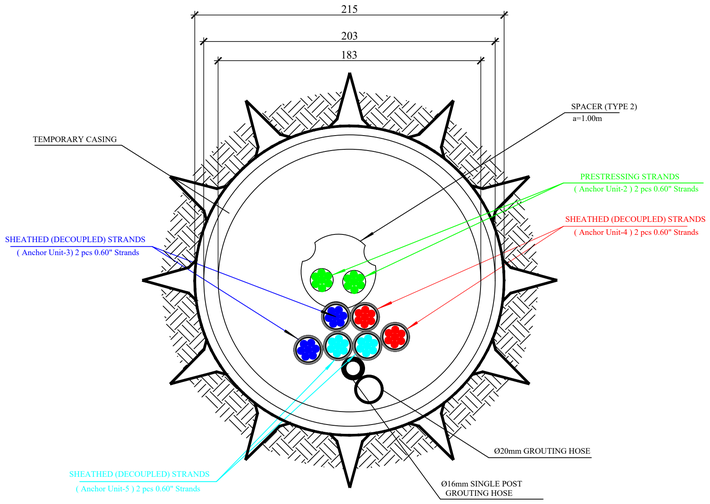
SECTION A-A


215
203
183
TEMPORARY CASING
SPACER (TYPE 2) a=1.00m
PRESTRESSING STRANDS (Anchor Unit-4) 2 pcs 0.60" Strands
Ø20mm GROUTING HOSE
SHEATHED (DECOUPLED) STRANDS (Anchor Unit-5) 2 pcs 0.60" Strands
Ø16mm SINGLE POST GROUTING HOSE

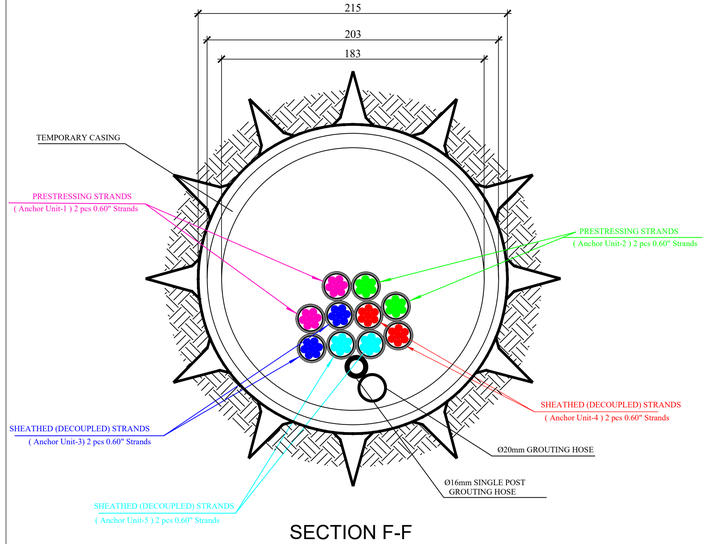
SECTION B-B


215
203
183
TEMPORARY CASING
SPACER (TYPE 2) a=1.00m
PRESTRESSING STRANDS (Anchor Unit-3) 2 pcs 0.60" Strands
SHEATHED (DECOUPLED) STRANDS (Anchor Unit-4) 2 pcs 0.60" Strands
Ø16mm SINGLE POST GROUTING HOSE
Ø20mm GROUTING HOSE
SHEATHED (DECOUPLED) STRANDS (Anchor Unit-5) 2 pcs 0.60" Strands

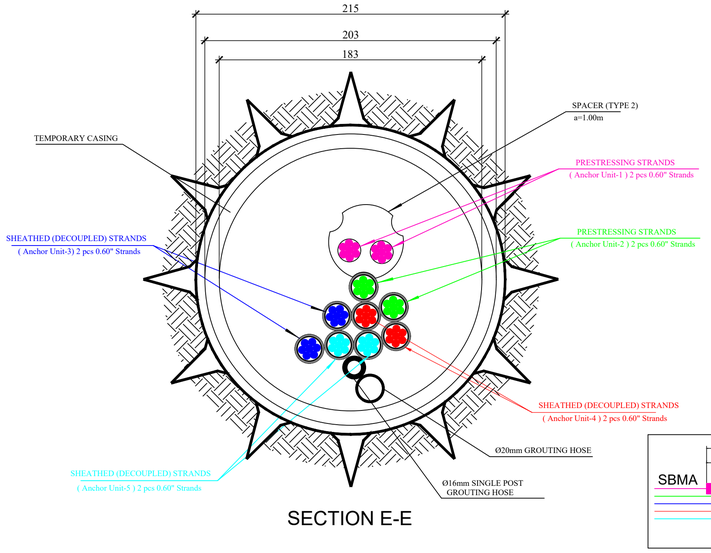
SECTION C-C


215
203
183
TEMPORARY CASING
SPACER (TYPE 2) a=1.00m
PRESTRESSING STRANDS (Anchor Unit-2) 2 pcs 0.60" Strands
SHEATHED (DECOUPLED) STRANDS (Anchor Unit-4) 2 pcs 0.60" Strands
SHEATHED (DECOUPLED) STRANDS (Anchor Unit-3) 2 pcs 0.60" Strands
Ø20mm GROUTING HOSE
SHEATHED (DECOUPLED) STRANDS (Anchor Unit-5) 2 pcs 0.60" Strands
Ø16mm SINGLE POST GROUTING HOSE

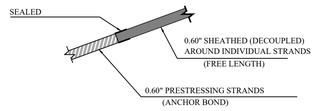
SECTION D-D


215
203
183
TEMPORARY CASING
PRESTRESSING STRANDS (Anchor Unit-1) 2 pcs 0.60" Strands
PRESTRESSING STRANDS (Anchor Unit-2) 2 pcs 0.60" Strands
SHEATHED (DECOUPLED) STRANDS (Anchor Unit-3) 2 pcs 0.60" Strands
SHEATHED (DECOUPLED) STRANDS (Anchor Unit-4) 2 pcs 0.60" Strands
Ø20mm GROUTING HOSE
Ø16mm SINGLE POST GROUTING HOSE
SHEATHED (DECOUPLED) STRANDS (Anchor Unit-5) 2 pcs 0.60" Strands

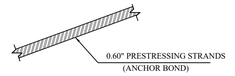
SECTION F-F


215
203
183
TEMPORARY CASING
SPACER (TYPE 2) a=1.00m
PRESTRESSING STRANDS (Anchor Unit-1) 2 pcs 0.60" Strands
PRESTRESSING STRANDS (Anchor Unit-2) 2 pcs 0.60" Strands
SHEATHED (DECOUPLED) STRANDS (Anchor Unit-3) 2 pcs 0.60" Strands
SHEATHED (DECOUPLED) STRANDS (Anchor Unit-4) 2 pcs 0.60" Strands
Ø20mm GROUTING HOSE
Ø16mm SINGLE POST GROUTING HOSE
SHEATHED (DECOUPLED) STRANDS (Anchor Unit-5) 2 pcs 0.60" Strands

SECTION E-E



Ⓐ DETAIL



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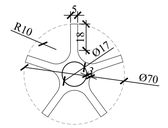
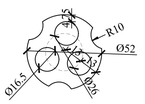
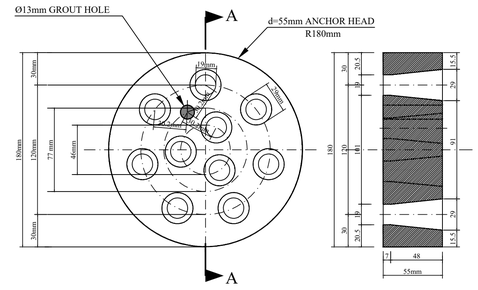


(TYPE 1)



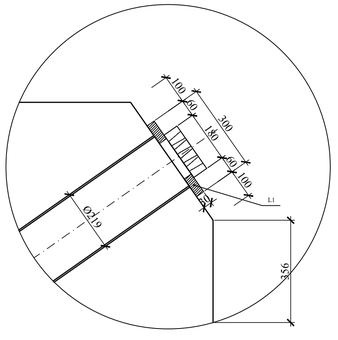
(TYPE 2)

SPACER DETAIL

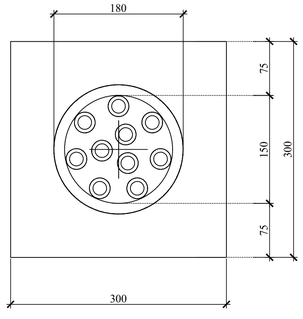


ANCHOR HEAD TOP VIEW

SECTION A-A

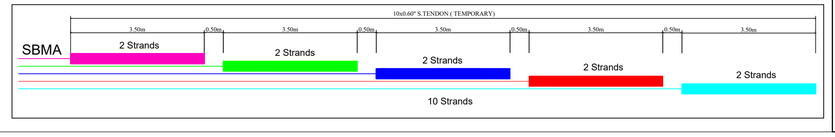


L1 ⊄ 30x300x300
ANCHOR PLATE DETAILS
Ⓒ DETAIL



L1 ⊄ 30x300x300

10x0.60" S.TENDON (TEMPORARY)
SBMA SCHEMA



GENERAL NOTES

1- MATERIALS :

CONCRETE :
C35 Concrete with min. compressive strength of 35 N/mm² shall be used for RC beam.

REINFORCEMENT :
B500A,B (min. fyk = 500 MPa)

2- CONCRETE COVER :

The minimum clear cover to steel reinforcement shall be as follows.
Shoring Bored Piles Ø1200mm : 50-60mm from Casing
Head Beam : 50mm

3- LAP LENGTH of REBAR

For the head beam, lap length shall satisfy min. 50Ø for longitudinal rebars. Also, stirrups spacing shall be 10 cm for lab region.

4- SCALE :

Unless otherwise indicated on drawings all distances are in cm, elevation in meters, and reinforcement bar sizes in mm.

NO.	DATE	REVISION
A		
A		
A		
A		
A	26.10.2023	GENERAL REVISION

PROJECT NAME: SAUDI PORTS AUTHORITY
JEDDAH ISLAMIC PORT

SUB-CONTRACTOR: KASKTAS ARABIA LTD.
PILING , DRILLING CONTRACTING CO. LTD.
P.O.Box 15995 Jeddah 21444 KSA Tel:00966-2-6680229 Fax:00966-2-6602704
web site: www.kasktas.com.tr email: kasktas@kasktasarabia.com

	NAME	DATE	SIGNATURE
DRAWN BY	ÖMER ÇELEBİ	12.04.2023	
DESIGNED BY	AHMET DİNÇ	12.04.2023	
CHECKED & APPROVED BY	ŞENOL ADATEPE	12.04.2023	

PROJECT-DRAWING TITLE : 10x0.60" S.TENDON (TEMPORARY) ANCHOR DETAILS
PROJECT NO : 2023-U-SA-01
SCALE 1/200
DWG. NO. KASK-2023-U-SA-01-DE-DWG-013-R01

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